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EMBRYOLOGY.[1]

The Development of Paludina vivapara.[2]—R. von Erlanger contributes two papers on this subject which form a comprehensive and valuable study of the development of this species. He describes concisely and clearly the development of the tissues and organs, giving special attention to the origin of the mesoderm and to the formation of the pericardium, heart, primitive kidneys, permanent kidneys, renal ducts, reproductive organs, and nervous system. The author had an abundance of material and believes he was able to fully verify all his results. Heretofore no one has succeeded in keeping alive the embryos after removing them from the opaque albuminous capsule which encloses them. The author found they would live for a time in a solution of 20cc. of egg albumen, 1g. of common salt and 200cc. of water; so that he was able to observe the processes of development in the living embryo. Of the fixing agents used Kleinenberg's picro sulphuric acid with a drop of 5% osmic acid added was by far the most successful.

The mesoderm arises from the archenteron at the time of the formation of the velum. The ventral wall of the archenteron pushes out as a single large sac, which soon pinches off from the rest of the entoderm. For a time it has the form of a closed vesicle lying in the ventral half of the embryo between the ectoderm and entoderm. This vesicle enlarges, its cells becoming somewhat flattened in the process. Later the walls of the vesicle break up into their constituent cells, the disintegration beginning at the mid-ventral point of the vesicle. Some of the cells apply themselves to the ectoderm (somatopleure), some to the entoderm (splanchnopleure), others, star shaped, form an extensive net-work filling the segmentation cavity; processes from the somatopleuric and splanehnopleuric mesoderm cells also join the net-work. The different organs now begin to make their appearance. The coelom of Paludina, according to this description, arises as a single, median, ventral evagination from the archenteron.

At the time when the rudiment of the stomadæal invagination appears there can be seen in the posterior part of the embryo, below the ventral wall of the gut, a paired mass of spindle-shaped mesoderm cells (each half of this mass of cells contains a cavity). This is the rudiment of the pericardium. It varies greatly in different individuals, but always has a paired origin. The two halves fuse later, but for a considerable time there remains a septum between the cavities of the two sides. The right cavity is from the first the larger of the two. Erlanger says: "I was not able in Paludina to see the immediate transformation of the coelom into the pericardium, since the whole secondary body cavity is so early wholly filled with irregularly disposed, spindle-shaped mesoderm cells; yet the rudiment of the pericardium is formed between the two mesoderm layers, one of which clothes the inner surface of the ectoderm, the other the outer surface of the gut.

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[1] This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2] Zur Entwicklung der Paludina vivapara. R. von Erlanger, Morph. Jahrb., vol. xvii, 1891; Part I, August; Part II, October.

"The question then arises whether the pericardium represents the whole secondary body cavity (which would be greatly reduced) or merely a part of it, so that then the rest of the coelom would coincide with the primary body cavity or segmentation cavity. I now incline toward the second view, and think that the coelom only partially persists as such in the pericardium, while by far the greater part of it is obscured by the spindle-cells which fill it and so simulates the primary body cavity [—und daher sich mit der primären Leibeshöhle deckt]. The development of Paludina, described in this paper, appears to me to uphold this conclusion, and my other not yet completed researches in regard to the manner of formation of the blood-vessels strengthens me in this view."

The kidneys arise as evaginations, right and left, of the pericardial wall, while the embryo is still untwisted. They are first indicated by thickened areas of this wall. These thickened areas push out toward the mouth chamber until they assume a tubular form. The rudiments of the renal ducts arise at the same time with the latter, as evaginations, right and left of the walls of the mantle chamber, toward the rudiments of the kidneys. The right kidney rudiment and the rudiment of the right renal duct unite to form the permanent kidney. The left kidney is never fully formed, its rudiment never uniting with that of the left renal duct. Each of these persist for a time, but during the subsequent spiral twisting of the embryo each is obliterated. The secretory portion of the kidney arises then, from mesoderm and not from ectoderm, as has been claimed. Its excretory duct arises from the ectoderm of the mantle chamber.

The heart arises as an invagination of the dorsal area of the pericardium, forming an antero-posterior furrow. Soon this furrow constricts in the middle, indicating the line of demarkation between auricle and ventricle. The heart furrow sinks more and more into the pericardial sac until it becomes a closed tube distinct from the latter, except at its two openings, one on the originally anterior, the other on the originally posterior face of the pericardium. At the same time the heart has divided into an auricle (posterior) and a ventricle (anterior), as was before indicated by the constriction in the heart furrow.

By the twisting of the body of the embryo the heart is brought upon the left side and the kidney to the middle line. The kidney grows larger, its opening into the pericardium becomes narrower, and the external orifice of the renal duct grows smaller and smaller. At the same time the cells of the wall of the kidney enlarge and in different places the walls push into the lumen of the gland, forming strands which by further development are converted into a mass of spongy tissue. The kidney, then, is not a typical acinous gland.

The primitive kidneys ("Urnieren") arise from mesoderm, one on each side of the embryo, just behind the velum. They first appear at the time of the stomadæal invagination, while the embryo is still wholly symmetrical. Each rudiment is at first a solid mass of cells. Soon a cavity appears within the mass, and at the same time it approaches the surface. It soon breaks through the ectoderm cells to the surface. Its cells can be distinguished from the ectoderm and the rest of the mesoderm by their large size, clear protoplasm and deeper staining. It is still a closed vesicle. Now it elongates, becoming tubular, and soon it gains an external opening. There is no internal opening for the primitive kidney. Its inner end is formed by a mass of spindle-shaped and star-shaped mesoderm cells, at least one of which bears long cilia, which are active in the living embryo. No concretions or excretory granules are present. In the absence of any internal opening the primitive kidney of Paludina resembles the excretory organs of Plathelminths, "yet it may be possible that this departure from the ordinary condition is only the result of a certain degeneration." Erlanger thinks that in the pair of primitive kidneys and the pair of permanent kidneys (only one of which fully develops) we may have represented the segmental organs of two segments, comparable to the segmental organs of the worms.

The author shows that each of the ganglia of the nervous system arises by a sort of delamination from thickened areas of the ectoderm. All but the visceral ganglion arise from paired rudiments. The visceral ganglion arises from a single thickening of the wall of the mantle chamber near the pericardium.

There is no "Scheitelplatte," the two rudiments of the cerebral ganglia being from the first distinct. They arise by delamination from two distinct thickenings of the ectoderm of the pre-velar area, situated one on the right, one on the left of the centre of the area.

The pedal ganglia next appear, arising in the same way by delamination from two distinct ectodermal thickenings. The pallial ganglia develop from similar paired rudiments. The buccal ganglia are formed later from paired thickenings of the ectoderm of the ventral wall of the stomodæum. Two thickenings of the anterior border of the mantle give rise to the two intestinal ganglia, which are at first right and left. The twisting of the embryo soon brings the right one above the intestine (supraintestinal ganglion) and the left one below (subintestinal ganglion). The subintestinal ganglion does not appear in the adult. The visceral ganglion is formed from the posterior part of the floor of the mantle chamber. It arises from the ectoderm, but does not have a paired origin, differing in this respect from all the other ganglia.

As seen in the order of description, the ganglia arises progressively from before backward. The commissures and connectives arise in the same order. The cerebral ganglia first connect with each other, then with the pallial, the pedal and the buccal ganglia. The pedal ganglia next unite and then the buccal ganglia. No commissure connects the pallial ganglia. Of all the connectives between the cerebral ganglia and the other nerve centres the cerebro-pedal connectives are the last to appear. This is the only exception to the rule that the nervous system develops progressively from before backward. Because of the small size of the ganglion cells Erlanger was unable to demonstrate the origin of the nerve fibres.

"The circulatory system of Paludina arises in the manner typical for the Mollusca."

The origin of the sexual organs is interesting. It is the same in both sexes. The ovary, or testis, is formed from an evagination of a portion of the pericardium, almost, or exactly, in the place where earlier the rudimentary left kidney was formed. The duct arises as did the rudimentary left renal duct and from the same region of the mantle chamber. The tubular rudiment of the "sexual gland" separates from the pericardium and forms a hollow vesicle, which, later, connects with the sexual duct. The sexual organs are formed, then, apparently by the reopening of the left kidney, which appeared and atrophied at an earlier stage in the development. This manner of development, though peculiar, corresponds fundamentally to the Molluscan type. The renal ducts probably originally served as sexual ducts also (e. g. Chiton). In Paludina we have, associated with the twisting of the body, a differentiation in function, by which the right uro-genital duct comes to serve simply as a renal organ and the left as a sexual organ.

Among the most valuable features of this paper is the review of the literature of the subject. The author's discussion of the relationship of the Mollusca to the annelids and flat worms is not so important. Many points in the paper and some whole sections (e. g. the development of the sense organs) have been passed over in this brief review. I trust, however, that reference has been made to the points of special interest, and such points are not few. The author's clearness and conciseness of statement make his paper a very readable one.—MAYNARD M. METCALF.

ENTOMOLOGY.

Classification of the Mites.—A paper of much value to students of the Acaroidea has recently been published[1] by Dr. Trouessart. It is entitled "Considérations générales sur la classification des acariens, Suivies d' un essai de classification nouvelles." The author first gives a historical sketch of the classifications that have been proposed for the group, from that of Latreille in 1795 to that of Canestrini in 1891. He then discusses the characters upon which the classification should be based, gives the tabular statement of his new classification (translated on the following page) and concludes with a useful review of the families, subfamilies and genera, with the characters of the families and subfamilies. Dr. Trouessart thinks the mites should form the sub-class Acaroidea, of the class Arachnida, and divides them into two orders, the Acarina and the Vermiformia.—C. M. W.

Color Preferences of the Carpet Beetle.—During the past May the Buffalo carpet beetles (*Anthrenus scrophulariæ*) have been abundant on the tulip beds at Hanover, N. H., taking advantage, no doubt, of the open windows of the house-cleaning period to fly out and get some pollen for food. In a small bed containing about three dozen tulips, three-fourths of which were of red colors, and the rest of white and

[1] Revue des Sciences Naturelles, 1892.